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Newfoundland and Labrador Region
Canadian Science Advisory Secretariat
Science Advisory Report 2013/066

SUBDIVISION 3PS OFFSHORE WHELK: A PRELIMINARY ASSESSMENT OF MALE SIZE AT MATURITY

Image: Whelk (Buccinum undatum)

Figure 1: Northwest Atlantic Fisheries Organization (NAFO) Subdivision 3Ps Whelk fishing grounds

Context:

The commercial fishery for the Common Northern or Waved Whelk (Buccinum undatum) began in Newfoundland and Labrador in 1986. Initially, the fishery was restricted to localized inshore areas in southern Labrador and insular Newfoundland with whelks supporting short-term pulse fisheries that waxed and waned due to market demand and resource availability. In the early 2000s the fishery in offshore Subdivision 3Ps developed and expanded rapidly. The fishery is currently concentrated in three distinct offshore areas (not DFO management areas), known as the North, West and South grounds, with a fishing season running from April 1-September 30. The fishery is competitive, with an established pre-emptive Total Allowable Catch (TAC) of 5,000 t, and is restricted to core fishers who prosecute the fishery by using long-line fleets of baited conical traps at depths ranging from 45-60 m. Each enterprise is permitted to fish up to 500 traps. Fishers must complete and submit mandatory fishing logbooks. Data used to calculate effort and Catch per Unit Effort (CPUE) are derived from logbooks. The minimum legal size that may be landed is 63 mm shell height; sorting of undersized whelks must be done on the fishing grounds. There is no biological basis for this size limit. Rather, it is determined by industry requirements. A Vessel Monitoring System (VMS) is in place to track vessel fishing activities.

A Regional Advisory Process (RAP) was convened February 27-March 6, 2013 to update the available information on whelks with emphasis on the size at which sexual maturity is attained. Participants included Fisheries and Oceans Canada (DFO) Scientists, Fisheries managers, representatives from Industry, the Provincial Government and Memorial University.

Canada

SUMMARY

- Total landings for offshore Subdivision 3Ps in 2011 were 5,819 t. More than half the landings (61%) were from the South grounds, with the North and West grounds contributing 29% and 10% respectively. The fishery on the West grounds is recent, beginning in 2007, and is much smaller in area than either the North or South grounds.
- Catch per Unit Effort indicates that fishery performance has gradually improved since 2007.
- There was no apparent relationship between size and maturity for females.
- Revised size at 50% maturity for males was 61.7 mm shell height; however, this is an imprecise estimate due to sampling limitations.

BACKGROUND

Species Biology

The life cycle and biology of the Waved Whelk are reviewed in Rochette (2009). The Waved Whelk (*Buccinum undatum*) is a boreal neogastropod of the Atlantic Ocean. In the western north Atlantic, it is found from New Jersey to Labrador. It is a relatively large and long-lived gastropod that attains up to 120 mm in shell height and >10 years of age. It is more active in colder water and tolerates salinities down to ~20 ppt. It is found on various types of substrates (boulders, cobbles, mud) but occurs in greatest densities on soft bottoms at 15-30 m depth.

The Waved Whelk has a large muscular foot which it uses to crawl over the seafloor. It has been reported to crawl to baited traps at speeds of 7-15 cm/minute and from distances of 20-30 m. Detection and localization of food is likely via chemotaxis and a specialized organ in the whelk's mantle cavity, the osphradium. Whelks appear to have a broad diet and varied means of acquiring food. They feed on live and dead animal tissues using a long eversible proboscis which is an extension of the digestive system. Predators include sea stars, arthropods (crabs and lobsters), and fishes (e.g., wolf eels). Although whelks are highly mobile, they spend much of their time stationary on the bottom or buried in the sediments, sometimes with only the siphon protruding.

This species is dioecious (separate sexes) and fertilization is internal. Whelks are polygamous; females store sperm from many males. There is virtually no information on critical reproductive processes such as mate choice and sperm competition. Sexual maturation is relatively slow with maturity probably reached at 4-7 years of age depending on gender and location. Females mature at an older age and larger size than males. Females lay their embryos inside capsules which they attach to hard structures such as rock. Embryos undergo complete (direct) development within 3-8 months before emerging as crawling whelks. Larger females lay a greater number of capsules than smaller ones but the number of embryos per capsule (~2500-3000) seems independent of female size. Less than 1% of embryos likely survive in nature, mainly because many serve as nurse eggs for earlier-developing individuals and also because other animals, particularly sea urchins, prey upon them. In the northern Gulf of St. Lawrence, copulation and egg deposition occur in spring and summer with juveniles emerging from capsules in late autumn and winter, while in Europe, copulation and egg-laying occur in autumn. The period for mating and egg laying in Subdivision 3Ps offshore is unknown. Adult whelks are reported to feed less during mating and egg-laying than at other times.

Because of its seemingly high 'catchability' (attraction to baited traps), low reproductive rate (see above), and limited dispersal, this species is thought to be susceptible to localized over-exploitation, and has been extirpated in some areas of its range. Populations are isolated due to

the absence of a pelagic larval stage and limited movement of adults. Not surprisingly, Waved Whelk populations display marked variation in different phenotypic traits such as size at sexual maturity. Susceptibility to local extinctions and high potential for local adaptation suggest micromanagement of commercially exploited whelk populations may be desirable, for both economic and conservation purposes.

The Fishery

The fishery began in inshore areas of Labrador and Insular Newfoundland in the mid-1980s. Since then this fishery has been prosecuted on an opportunistic basis dependent on market conditions and resource availability. There are three whelk fishing areas in offshore Subdivision 3Ps; North, West and South grounds (Figure 1). The fishery began in the North ground in 2004 with landings of 690 t and expanded rapidly thereafter, in terms of number of active licenses, area fished and total landings (Fig. 2). Landings first peaked at 5,788 t in 2008 and dropped by 16% to 4,855 t in 2009 before increasing slightly to 5,252 t in 2010 and reaching an historic high in 2011 at 5,819 t. The number of active licenses increased from 21 in 2004 to 58 in 2006 and has changed little since. The fishery has been prosecuted in offshore Subdivision 3Ps (Fig. 3) under a competitive quota of 5,000 t since 2008. Each fisher is restricted to 500 traps. Catch per Unit Effort indicates that fishery performance has gradually improved since 2007 (Fig 2). The whelk fishery extends from April to September and coincides with the Subdivision 3Ps offshore Snow Crab (*Chionoecetes opilio*) fishery, for which most offshore whelk fishers are also license holders. This may result in delays in the start of the whelk fishery as fishers usually complete the crab fishery before prosecuting the whelk fishery and could allow females a chance to deposit their egg masses before being captured.

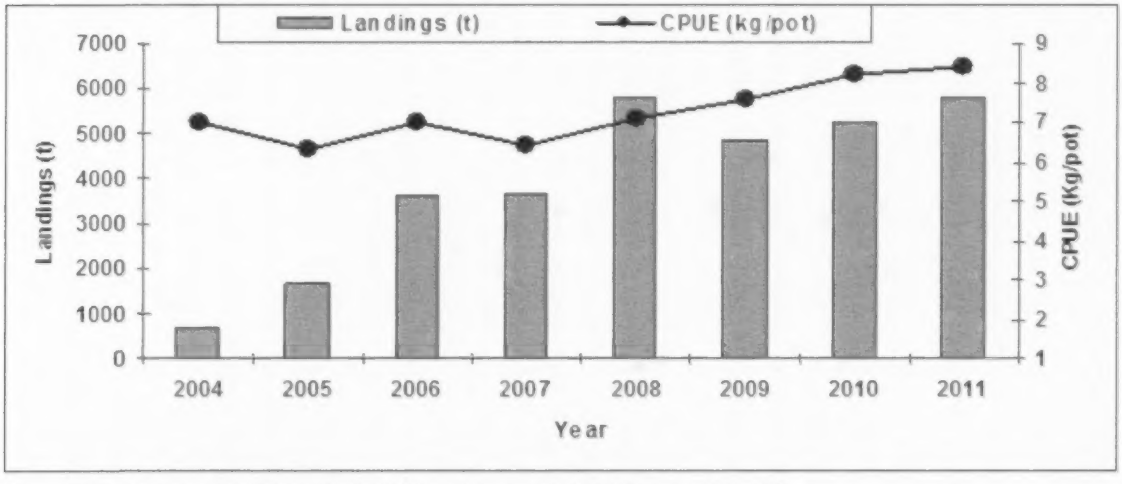

Figure 2: Summary of offshore Subdivision 3Ps whelk landings and CPUE.

Figure 3: Distribution of whelk fishing effort in Subdivision 3Ps offshore 2004-11.

ASSESSMENT

Size at Maturity

Data on size (shell height) at sexual maturity were acquired for whelks collected from four and six commercial trap catches during the 2010 and 2011 fisheries respectively. The 2010 samples were only from the South bed, whereas in 2011, both the Northwest and South beds were sampled. All samples were frozen and transported to the laboratory for dissection. Maturity was determined for males only because there was no apparent relationship between size and maturity for females. This problem is common throughout the species range. Male maturity was determined by the relationship of penis length to shell height, with maturity defined as penis length being greater than 50% of shell height.

Results from the 2011 samples indicated that size at 50% maturity for males was at 62 mm shell height (Table 1 and Fig. 4) as compared to 59 mm from the previous year. However, there is uncertainty about these estimates as there are broad confidence intervals around the logistic regression model (Fig. 4).

Our estimate of size at 50% maturity (62 mm) is below the current legal size in the Newfoundland region of 63 mm, and well below the legal size of 70 mm in the Quebec fishery.

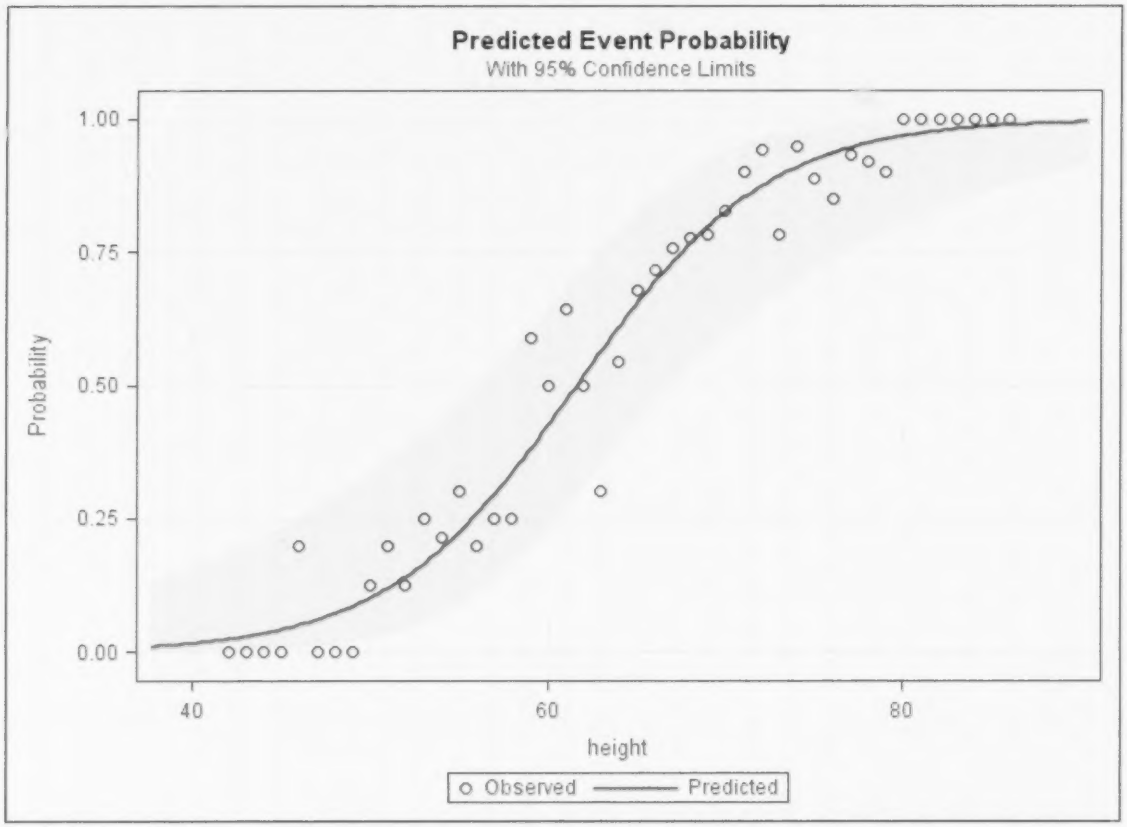

Figure 4: Size at 50% maturity of male Whelk from the Northwest and South beds of Subdivision 3Ps sampled in 2011. The shaded area represents 95% confidence limits.

A matrix of percent maturity of male whelk at shell height based on 2010 and 2011 data is given in Table 1. If the 70 mm legal size currently in force in the Quebec Region was adopted for male whelks in Subdivision 3Ps ~80% of the males from the 2010 and 2011 commercial samples would be mature.

Table 1: Matrix of probability of male maturity-at-height for Subdivision 3Ps male whelks

Probability of Maturity	2010 Height (mm)	2011 Height (mm)
0.4	55.7	59.5
0.45	57.4	60.6
0.5	59.0	61.7
0.55	60.6	62.7
0.6	62.2	63.9
0.65	63.9	64.9
0.7	65.7	66.2
0.75	67.7	67.5
0.8	70.0	69.1
0.85	72.7	70.0
0.9	76.4	73.4
0.95	82.3	77.4

Sources of Uncertainty

There is inadequate information on the reproductive potential of the population. While probability of size at 50% maturity of Subdivision 3Ps male whelks has been calculated areal coverage of is limited. Information on female size at 50% maturity remains unknown and difficult to determine.

Data on all other aspects of reproductive biology such as frequency of egg capsule deposition, number of embryos surviving to juvenile stage per capsule cluster and development time of encapsulated embryos are unknown for this area. Growth rates for both male and female whelks are also unknown.

CONCLUSIONS AND ADVICE

The current minimum legal size of 63 mm ensures that about half the male population can reproduce before recruiting to the fishery. However, the efficacy of this as a conservation measure is unknown, largely because size-at-maturity of females is unknown. Therefore, it would be prudent to carefully monitor stock status for indications of resource decline.

In addition, increased at-sea observer sampling is necessary to determine levels of potential discard mortality and recruitment. Research into growth rates and methods of promoting exclusion/retention of undersized whelks from traps is also needed.

MANAGEMENT CONSIDERATIONS

More comprehensive biological data necessary for the provision of advice to assist in formulating management strategies are not available. However, it appears that the resource, as reflected by fisheries statistics, is currently being exploited at a rate that may not be detrimental to its sustainability.

As it is not possible to visually determine the sex of whelks upon capture, options such as a "male-only" fishery regulation are not practical and cannot be enforced.

SOURCES OF INFORMATION

This Science Advisory Report is from the Fisheries and Oceans Canada, Canadian Science Advisory Secretariat, Regional Advisory Meeting of February 27-March 6, 2013 on Snow Crab in NAFO Divisions 2HJ3KLNO, Subdivision 3Ps and Division 4R; Subdivision 3Ps Whelk. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

DFO. 2009. Proceedings of a Workshop on Canadian Science and Management Strategies for Whelk; 3-4 June 2008. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2009/024.

Rochette, R. 2009. Ecology of the Whelk Buccinum undatum: An Overview. In: DFO. 2009. Proceedings of a Workshop on Canadian Science and Management Strategies for Whelk; 3-4 June 2008. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2009/024.

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